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DIMENSIONS OF THE SCIENCE LITERACY LEARNING ENVIRONMENT: SYSTEMATIC LITERATURE REVIEW USING THE PRISMA METHOD

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Abstract

This systematic literature review attempts to analyze various dimensions related to measuring the scientific literacy learning environment. Scientific literacy skills for students are very important in preparing to face the challenges of the modern world. Learning environments that support scientific literacy enable students to develop a holistic understanding of science and technology, including how science can be used to protect the environment and confront global threats. One approach to literature study is Systematic Literature Review (SLR). This research uses a Systematic Literature Review using the Prisma Method with the help of a VOS viewer. This research was limited by only searching for Scopus journal articles published in 2019-2024. Based on one hundred and nineteen (119) articles reviewed, through a systematic literature review process, with an article publication period between 2019 and 2024, the results were that only twenty (20) articles met the criteria and were used as references in this research. Based on the results of the systematic literature review analysis, it was concluded that the dimensions of the scientific literacy learning environment consisted of: science phenomena, science investigations, interest in science in free time, enjoyment of science, teacher support, student cooperation/cohesion, and the social implications of science.

Keyword: Learning Environment, Scientific Literacy, SLR, Prisma.

INTRODUCTION

Evaluation of education in Indonesia is an important aspect in understanding the effectiveness of the national education system and the quality of learning at various levels. In general, educational evaluation is carried out to measure the extent to which educational goals have been achieved, both at the individual student, school and national education policy levels. One important evaluation method in education in Indonesia is the Program for International Student Assessment (PISA), an international survey conducted every three years by the Organization for Economic Cooperation and Development (OECD). PISA is designed to measure the competency of 15-year-old students in three main areas: reading literacy, mathematics and science. The PISA evaluation focuses on students'

ability to apply knowledge in real situations, thereby reflecting the quality of a country's education in preparing the younger generation to face global challenges.

Scientific literacy skills for students are very important in preparing to face the challenges of the modern world. Scientific literacy is not only about understanding scientific concepts, but also includes the ability to think critically, solve problems, and apply scientific knowledge in everyday life. In this information age, students are faced with a flood of information that is not always accurate or scientifically based. With scientific literacy, students can assess the validity of information, especially in issues related to health, the environment, and technology.

Scientific literacy also helps students develop analytical and critical thinking skills. When students are able to understand the scientific method and basic science concepts, it will be easier to analyze problems and formulate logical and measurable solutions. For example, in studying issues such as climate change or health, scientific literacy makes it possible to see problems from a more objective and evidence-based perspective. These skills are very important for future life, both in professional and personal contexts.

In addition, scientific literacy supports the formation of responsible attitudes towards the environment and health. When students have a strong understanding of science, they tend to be more aware of the impact of actions on the environment, such as the importance of recycling, reducing pollution, or sustainable use of natural resources. Students also better understand the importance of maintaining health through a healthy lifestyle, such as choosing nutritious foods and understanding how the human body works.

In an increasingly complex world, scientific literacy helps students to develop into informed citizens who are able to participate in public discussions regarding science and technology issues. By having good scientific literacy, students are not only ready to face academic challenges but are also ready to become individuals who contribute positively to society and the environment in the future.

According to the OECD (2019), scientific literacy is defined as a person's ability to engage productively with issues related to science as well as the ability to think critically in dealing with problems that require scientific knowledge. This definition includes several key aspects, including understanding basic scientific concepts, awareness of the influence of science and technology in everyday life, and skills in applying scientific knowledge to make rational decisions.

Scientific literacy is not just theoretical understanding, but includes the skills to understand and assess scientific information that is relevant to real life, such as reading graphs, tables or experimental results. According to OECD (2019), scientific literacy also includes the ability to evaluate evidence and construct scientifically based arguments in the context of real problems. This includes identifying questions that can be answered scientifically, understanding the scientific method, and the ability to critically evaluate evidence and research results.

As part of the Program for International Student Assessment (PISA), the OECD emphasizes the importance of scientific literacy in preparing young people to face complex global issues, such as climate change, public health and rapid technological developments. Students who have good scientific literacy are expected to not only master basic scientific knowledge, but also be able to think critically and be actively involved in discussions and evidence-based decision making.

Thus, scientific literacy is considered essential to equip individuals with important life skills, especially in a world increasingly dominated by developments in science and technology. Through scientific literacy, a person is expected to become a conscious citizen and contribute positively to society, using scientific understanding to form responsible decisions in various aspects of life.

PISA results for scientific literacy show that Indonesian students' performance is relatively low compared to OECD countries and even several neighboring countries in Southeast Asia. From 2006 to 2022, the trend in Indonesia's science literacy scores tends to stagnate below average, reflecting challenges in improving the quality of science learning at the school level. In PISA 2006, the average scientific literacy score for Indonesian students was around 393, and although there was a small increase in 2015 to 403, this score is still far from the international standard expected by the OECD.

Scientific literacy ability can be defined as a person's ability to use scientific knowledge, think critically, and solve problems in real-world contexts. According to the OECD in the Program for International Student Assessment (PISA) framework, scientific literacy is defined as the ability to engage with scientific issues and scientific ideas as a reflective citizen (OECD, 2019). It includes the skills of understanding scientific concepts, identifying questions that can be investigated scientifically, and drawing conclusions based on scientific evidence to make reasoned daily decisions.

The learning environment refers to everything that forms the context in which the teaching and learning process takes place. This environment includes physical space, social interaction, use of technology, as well as an emotional and cognitive atmosphere that supports student learning activities. According to constructivism theory, the learning environment is a place where students interact with learning material, teachers, and friends to build their own understanding of the material. This makes the learning environment not just a physical space, but also an atmosphere, ways of interacting, and tools used in the teaching and learning process (Vygotsky, 1978).

Assessment of the scientific literacy learning environment can be realized through appropriate dimensions. Assessment through dimensions can provide input in the form of dimensions or aspects that can develop students' scientific literacy abilities in learning activities. This research focuses on a systematic literature review on the dimensions of the scientific literacy learning environment because no references have been found regarding the development of the dimensions of the scientific literacy learning environment.

RESEARCH METHODS

Systematic Literature Review

Processing previous research is a very vital aspect in research. A comprehensive review provides a strong basis for contributing to the progress of science. A review of previous research aims to enrich existing theory, develop related study areas, and provide guidance for future research. From this explanation, it can be concluded that the main aim of library research is not to provide theoretical contributions, but to clarify and classify findings from previous research (Priharsari, 2022). The systematic literature review approach uses a structured and transparent method in evaluating relevant literature in a particular field or subfield (Rowley & Keegan, 2020).

This research uses a systematic literature review method. Based on a systematic literature review, several researchers utilized applications such as Publish or Perish, Zotero, Mendeley, VOSViewer, and Microsoft Excel to select articles which were then analyzed descriptively (Watajdid et al., 2021). Systematic literature reviews emphasize the importance of a search process that can be repeated by other researchers. The aim of a systematic literature review is to change literature reviews which are often subjective in nature into more objective ones, thereby reducing the potential for bias from researchers.

Stages in Systematic Literature Review

The steps in searching are divided into several processes, namely identification, screening and included. This step is in accordance with the guidelines in PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses). Prisma is a series of evidence-based minimums that aims to help authors report on diverse systematic reviews and meta-analyses that assess benefits. Prisma focuses on ways in which authors can ensure transparent and complete reporting of this type of research (Sastypratiwi & Nyoto, 2020). The specific search range is 2019 – 2024.

Systematic literature reviews are limited to research in the form of articles. The articles used are articles that are research that have been reviewed and published in English language journals.

A research question is the process of determining research questions based on the chosen topic. This research question is how to analyze the various dimensions that have been used to measure the scientific literacy learning environment. The aim of the research is to analyze various dimensions that have been used to measure the scientific literacy learning environment.

This research presents search results regarding articles related to the topic of scientific literacy learning environments. The criteria for articles used as data were articles from 2019 to 2024. The literature search focused on the keywords science, literacy, learning, and environment so that a total of 119 articles were obtained which were accessed using Scopus.

RESULTS AND DISCUSSION

The literature search focused on the keywords science, literacy, learning, environment, from 2019 to 2024, so that a total of 119 articles were obtained which were accessed using Scopus. Bibliometric analysis was carried out using VosViewer, resulting in the following display.

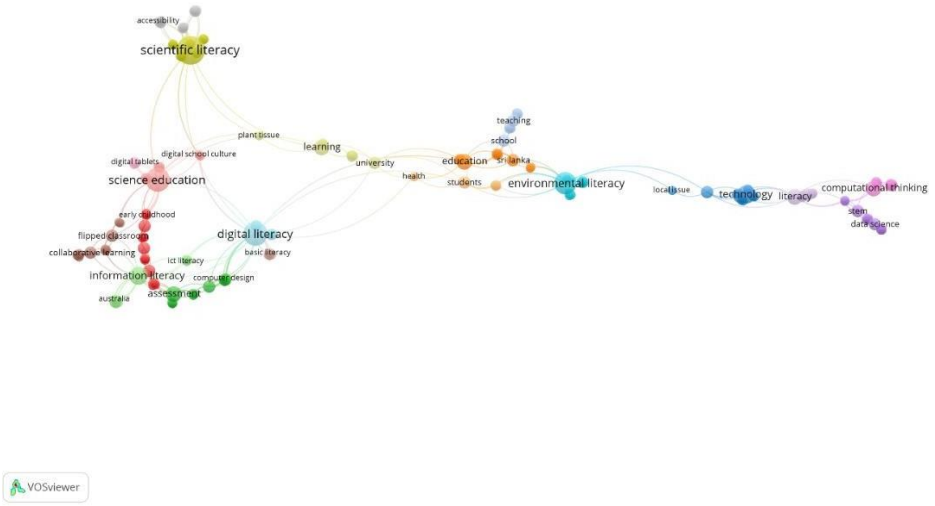

Figure 1. Relationship between keywords via VOSViewer
Source: processed by the author (2024)

From the VosViewer display, you can see the relationship between keywords, where the keywords are not connected to each other, this shows that there has been no systematic literature review study related to the dimensions of the scientific literacy learning environment.

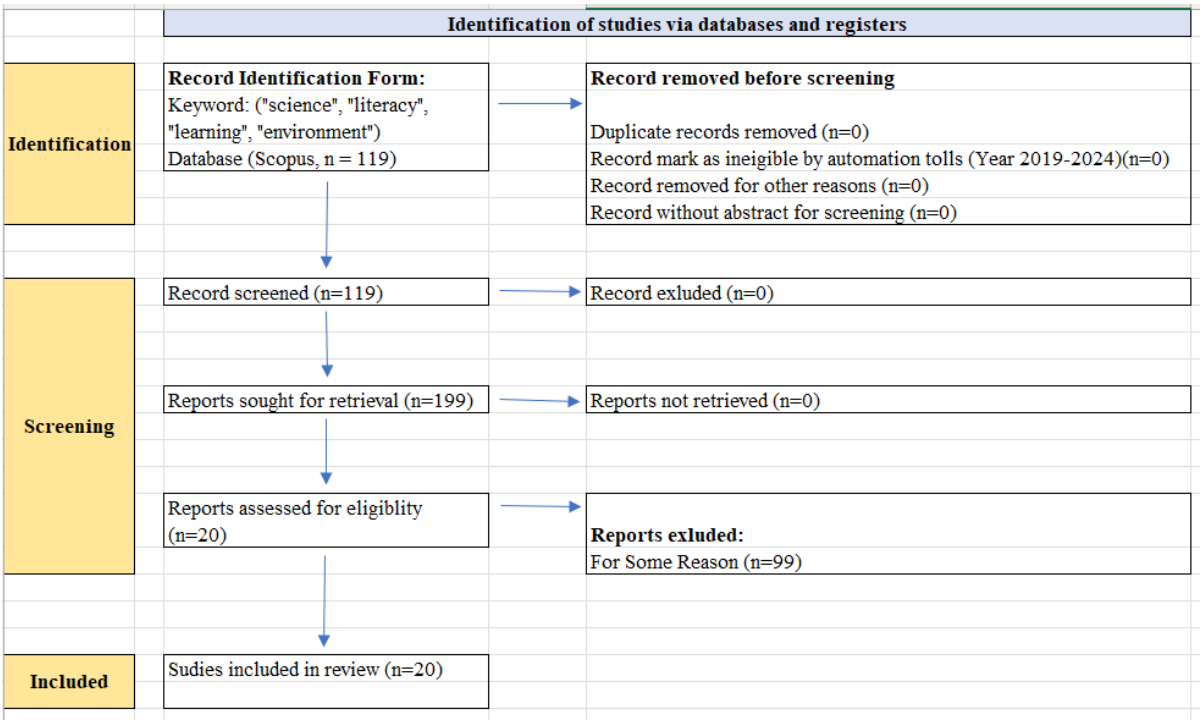

Figure 2. SLR with the Prisma method
Source: processed by the author (2024)

1. *Identification*
    - Based on the keyword search results in the Scopus database, 119 (one hundred and nineteen) references were obtained whose titles matched the keyword criteria entered in the query, namely *"science", "literacy", "learning", "environment"*.
    - Before screening, it was found that there were no duplicate articles, none were outside the year 2019-2024, there were no other reasons for discarding, and there were no articles without an abstract.

2. *Screening*
    - Screening was carried out on 119 articles without any articles being discarded.
    - Re-entered 119 articles, of which all 119 articles can be accessed.
    - Of the 119 articles, they will be evaluated to determine whether they meet certain criteria or requirements for inclusion in a study, analysis, or decision making. This process is usually carried out to ensure that the report is relevant and meets established standards before further use. So there are 20 relevant articles.
    - Relevant articles relate to the dimensions of the scientific literacy learning environment: dimensions of scientific literacy, dimensions of science attitudes (TOSRA), and dimensions of the learning environment (WIHIC).

3. *Included*
    - A total of 20 articles were relevant for analysis.

Table 1. Dimensional Mapping

No	Title	Dimensions
1	*Analysis of Competency Level for Wave Science in General Physics-Based on Literacy Science in PISA* Writer: Sahyar dkk.	Explain scientific phenomena; evaluate and design science investigations; interpret scientific data and evidence
2	*Analysis Of Students' Scientific Literacy Skill In Terms Of Gender Using Science Teaching Materials Discovery Model Assisted By Phet Simulation* Writer: Bahtiar dkk.	Science phenomena, data and scientific evidence
3	*A Study Of Grade Level And Gender Diflerences In Attitude Towards Nonlinear Pedagogy* Writer: Pasca Tri Kaloka dkk.	Career interests, leisure interests, attitudes toward scientific inquiry, social implications, and enjoyment in science.
4	*Attitudes towards science among senior secondary students in Fiji.* Writer: Mani Naiker dkk.	Social implications of science, normality of science, science inquiry attitude, science adoption attitude, science enjoyment, science leisure interest, science career interest
5	*Characteristics Of Students' Attitude To Physics In Muaro Jambi High School* Writer: Astalini dkk.	Social implications of science, normality of science, interest in science careers
6	*Enhancing secondary school students' attitudes toward physics by using computer simulations* Writer: Firas Tayseer Mohammad Ayasrah dkk.	Inquiry attitude toward science, enjoyment of science, interest in a science career
7	*Developing students' attitudes towards chemistry learning through culturally responsive transformative teaching (CRTT)* Writer:	Science inquiry attitude, adoption of science attitude, enjoyment of science greetings

	Annisah Aynun Najid dkk.	
8	*Validating Test of Science-Related Attitudes (TOSRA) For Elementary Students In Mataram, Indonesia* Writer: Rindu Rahmatiah, dkk	attitudes toward science investigations, adoption of science attitudes, enjoyment of science lessons, and interest in science in free time
9	*Attitude toward informal science in the early years and development of Leisure Time in Science (LeTiS), a pictographic scale* Writer: Esther Panos & Jose-Reyes Ruiz-Gallardo	Science fun
10	*The influence of inquiry-based learning on Indonesian students' attitude towards science* Writer: N. R. Sangkala & L. M. Doorman	Cooperation
11	*Does teachers' motivation have an impact on students' scientific literacy and motivation? An empirical study in Colombia with data from PISA 2015* Writer: Ana dkk.	Understanding science concepts, teacher support
12	*An Assessment of the Learning Environment and Teacher Interpersonal Behaviour at the Teacher Education Level* Writer: Adit Gupta & Priya Sharma	Teacher support
13	*Students' Perceptions of the Classroom Learning Environment and Engagement in Cooperative Mastery Learning-Based Biology Classroom Instruction* Writer: Emmanuel Bizimana dkk.	Student cohesion/cooperation
14	*A Reliability Generalization Meta-Analysis of "What Is Happening in This Class?" (WIHIC) Questionnaire* Writer:	Teacher support, involvement, investigation, cooperation, and equity

	Cherry Zin Oo dkk	
15	*Preservice teachers' perceptions of learning environments before and after pandemic related course disruption* Writer: Christopher S. Long dkk.	Student cohesion, teacher support, involvement, task orientation, and fairness
16	*Eflectiveness of project-based mathematics in first-year high school in terms of learning environment and student outcomes* Writer: Paul E. Rijken & Barry J. Fraser	Enjoyment, academic efficacy
17	*Structural relationships between learning environments and students' non-cognitive outcomes: secondary analysis of PISA data* Writer: Myint dkk	Investigation, teacher support, student cohesion/cooperation
18	*Exploring the association between non-specialised science teacher rates and student science literacy: an analysis of PISA data across 18 nations* Writer: Barbara Hanfstingi dkk.	Fun in science
19	*Nature of learning environment in concurrent enrollment mathematics classrooms: a cluster analysis* Writer: Stephen Stein & Peter Klosterman	Teacher support, engagement, student cohesion
20	*Assessing students' perceptions about classroom learning environments: the New What Is Happening In this Class (NWIHIC) instrument* Writer: Juan Cai dkk.	student cohesiveness, teacher support, involvement, task orientation, cooperation, fairness, differentiated instruction, and continuous evaluation

Source: processed by the author (2024)

Scientific phenomena are included in scientific literacy, based on research from Sahyar et al. (2020) and Bahtiar et al. (2022), that scientific phenomena are included in the

PISA competency framework. Scientific phenomena refer to events or happenings that can be observed and analyzed using a scientific approach. In a scientific literacy learning environment, this phenomenon is used to explore students' understanding of scientific concepts, such as natural laws, ecosystem interactions, and natural processes. Students are encouraged to observe, ask questions, and form hypotheses based on real phenomena, which supports the development of their critical thinking. So it can be concluded that the dimensions of scientific phenomena are included in the dimensions of the scientific literacy learning environment.

Several studies related to interest in science in free time, including Kaloka et al. (2022), Naiker et al. (2020), and Rahmatiah et al. (2024), shows that interest in science is included in the dimensions of their research dimensions related to science attitudes. An interest in science that develops outside of class time can strengthen the learning that occurs in the classroom and help students to deepen science in everyday life. A conducive scientific literacy learning environment can encourage students to explore their interest in science outside of school time. When students feel inspired by what they learn in class, they are more likely to seek out more information in their free time, whether through books, social media, videos, or simple experimental activities. Learning that combines theory and real experience makes students more interested in continuing their exploration of science outside school hours.

In Kaloka et al. (2022), Naiker et al. (2020), Ayasrah et al. (2024), Najid et al. (2021), Rahmatiah et al. (2024), Panos & Ruiz Gallardo (2021), Hanfstingl et al. (2024), and Rijken & Fraser (2024), show that the science enjoyment dimension is used to measure science attitudes. When science learning is packaged in an interesting, relevant and interactive atmosphere, students will experience deep enjoyment, which will increase their motivation to continue learning and exploring the world of science. In turn, these positive experiences also encourage positive attitudes toward science, strengthen their understanding, and make science an integral part of their lives.

In Kaloka et al. (2022), Naiker et al. (2020), and Astalini et al. (2019), shows that the dimensions of the social implications of science are used to measure science attitudes. The social implications of science in a scientific literacy learning environment facilitate students in connecting science with the social problems they face in everyday life. Learning that integrates social aspects not only makes students understand the role of science in society better, but also prepares them to become more socially aware, critical and responsible individuals in facing complex global challenges.

Several studies related to the dimensions of scientific investigation in the learning environment, including research by Oo et al. (2022) and Khine et al. (2020). Investigating science in a scientific literacy learning environment is very important to form students who not only understand scientific concepts, but also develop scientific skills that can be applied in everyday life. Investigation-based learning makes science more real and relevant for students, motivates them to continue searching for answers, and strengthens their abilities to think critically, collaborate, and communicate science ideas and findings.

Research related to the dimensions of teacher support in the learning environment, including research by Suarez-Mesa & Gomez (2024), Helms Lorenz et al. (2023), Oo et al. (2022), Long et al. (2022), Khine et al. (2020), Stein & Klosterman (2020), and Cai et al. (2022). Teacher support plays a key factor in creating a conducive scientific literacy learning environment. By providing direction, resources, and opportunities for students to engage in meaningful learning experiences, teachers help build a deeper understanding of science and science skills that can be applied in everyday life.

Research related to the dimensions of cohesiveness/cooperation in the learning environment, including research by Bizimana et al. (2022), Oo et al. (2022), Khine et al. (2020), Sangkala & Doorman (2019), and Cai et al. (2022). Student collaboration really supports the creation of a dynamic and effective scientific literacy learning environment. By working in groups, students not only deepen their understanding of science, but also develop social, communication, and problem-solving skills that are important for their lives and the development of future scientific careers. Collaboration in science learning facilitates a collaborative and inclusive environment, allowing students to learn in a holistic and integrated manner.

CONCLUSION

The dimensions of the scientific literacy learning environment consist of: science phenomena, science investigations, interest in science in free time, enjoyment of science, teacher support, student cooperation/cohesion, and the social implications of science.

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